eRD14 homework

Q: The committee would like to get more info on future plans
for the dRICH prototype. What is the goal?

A: The main goal of the prototype is to study the aerogel-gas interface to ensure that both radiators (in particular the aerogel) perform as intended (which was the case at HERMES, but not at LHCb). It will also validate key performance aspects of the simulations, and provide a platform for the development of the photosensor/readout solution (of particular importance for the SiPM option, which would involve cooling).

Q: What are the deliverables of the prototype?

A: The main deliverable would be performance data for the aerogel over time, possibly with different interface solutions. The aerogel characterization facility in Ferrara is currently being upgraded. Measurements of the PID performance of the prototype will also serve as a benchmark for the simulation of the full dRICH.

Q: What is the timeline?

A: The timeline will depend on the funding, but the prototype can be assembled as soon as all components are available – ideally in FY20.

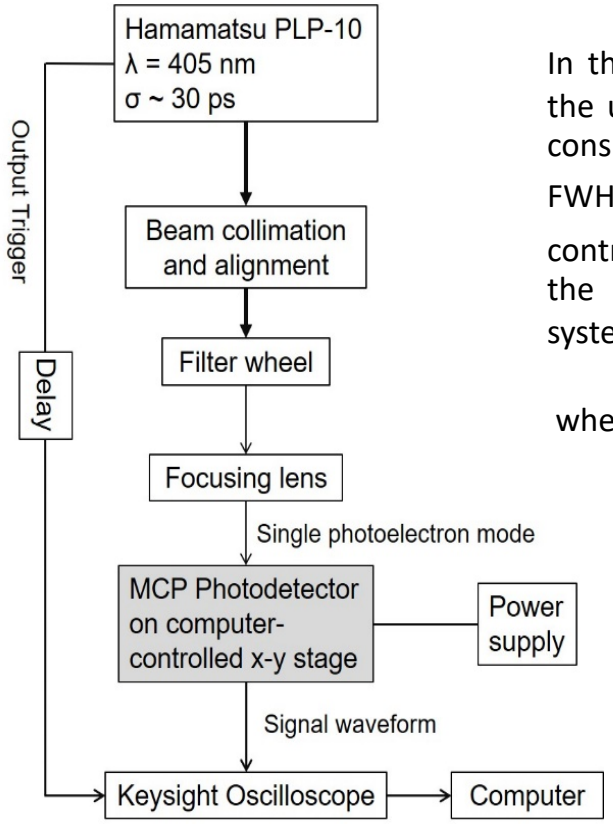
Q: What is the explanation of the disappearance of the tail in version 3 (see page 47)?

A: The tail mainly comes from backscattering. V3 has a 10 um pore size MCPs and a smaller photocathode-to-MCP spacing compared to that of V2 tube. Qualitatively, the smaller spacing mainly contributes to suppressed backscattering signal, and the smaller pore size MCP results in better timing. A more quantitative understanding would require simulations, although even smaller spacings may be pursued in the future to improve high-B performance, and a comparison will provide a consistency check.

		Version 2 **Standard 20 µm MCP-PMT**	**Version 3** **10 µm MCP-PMT** **without reduced spacing**	**Version 4** **10 µm MCP-PMT** **with reduced spacing**
MCP	Pore size	20 µm	10 µm	10 µm
	Length to diameter ratio (L/d)	60:1	60:1	60:1
	Thickness	1.2 mm	0.6 mm	0.6 mm
	Open area ratio	60 %	70 %	70 %
	Bias angle	8°	13°	13°
Detector geometry	Window thickness	2.75 mm	2.75 mm	2.75 mm
	Spacing 1	3.25 mm	2.25 mm	2.25 mm
	Spacing 2	1.75 mm	2.0 mm	0.7 mm
	Spacing 3	2.0 mm	4.0 mm	1.1 mm
	Shims	0.3 mm	0.3 mm	0.3 mm
	Tile base thickness	2.75 mm	2.75 mm	2.75 mm
MCP-PMT stack	Internal stack height	**9.70 mm**	**9.75 mm**	**5.55 mm**
	Total stack height	15.20 mm	15.25 mm	11.05 mm

Q: Describe the setup How many events had no photons?

A: The timing measurement system diagram is shown below and described in the text.



In the timing measurement system, the Hamamatsu PLP-10 was used as the ultrafast pulsed light source, and the laser synchronization pulse was considered as the reference signal. The laser has a pulse duration of 70 ps FWHM (Gaussian distribution $\sigma_{laser} = \frac{FWHM}{2\sqrt{2ln2}} = 30\ ps$), acts as a time jitter contributing to the time resolution measurement. The time resolution of the photodetector ($\sigma_{photodetector}$) can be extracted from the measured system resolution (σ_{system}) following equation:

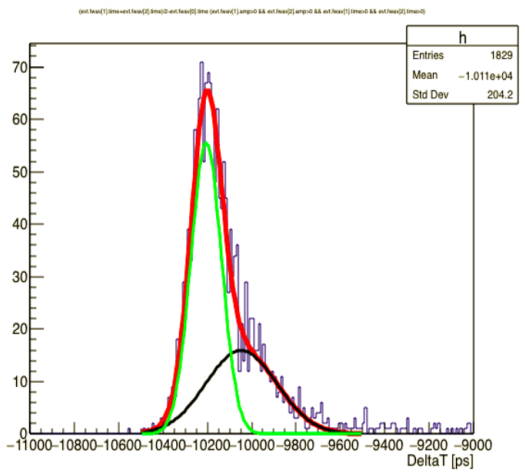
$$(\sigma_{system})^2 = (\sigma_{photodetector})^2 + (\sigma_{laser})^2 + (\sigma_{electronics})^2$$

where $\sigma_{electronics}$ is the contribution from electronics, measured to be ~ 7 ps.

Block diagram of the photodetector time characteristics measurement system

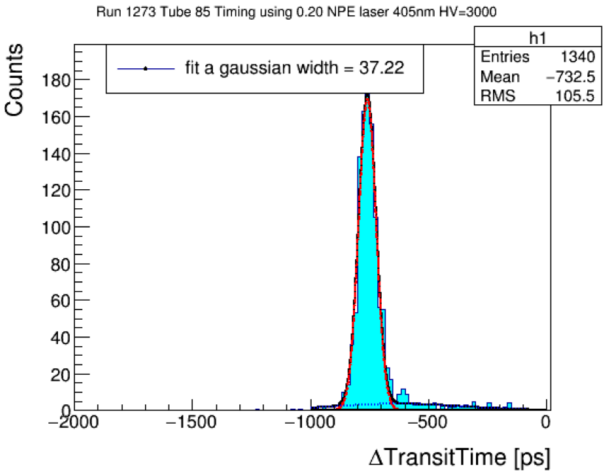
Q: How many events had no photons?

V2: 7000 events
1829 valid entries



$$\overline{N_{pe}} = -\ln\big(P(0)\big) = -\ln\frac{7000-1829}{7000} = 0.3$$

V3: 7000 events
1340 valid entries



$$\overline{N_{pe}} = -\ln\big(P(0)\big) = -\ln\frac{7000-1340}{7000} = 0.2$$

In both measurement, the light level is well below $\overline{N_{pe}} = 1$, ensuring single photonelectron mode.